JP10321598

Publication Title:

SEMICONDUCTOR DEVICE MANUFACTURING DEVICE

Abstract:

Abstract of JP10321598

PROBLEM TO BE SOLVED: To make the water treating conductions of the same type of many semiconductor device manufacturing devices constant by compensating the individual differences among the manufacturing devices by providing a high-frequency power source connected to a first electrode through a matching circuit and an impedance measuring and adjusting means having an impedance adjusting circuit connected to a second electrode. SOLUTION: High-frequency power from a high-frequency power source 5 is efficiently supplied to a plasma treating chamber 4 by connecting a matching circuit 6 to the lower electrode 2 of the chamber 2. Then an impedance measuring and adjusting device 20 having an impedance adjusting circuit 17 is provided between a ground 16 and an upper electrode 3 and an impedance is automatically adjusted while the impedance is displayed on a displaying section 21 so as to suppress the individual differences among many devices. When the impedance becomes a prescribed value, a wafer 1 is treated with plasma by connecting the adjusting circuit 17 to the upper electrode 3 and ground 16 by means of change-over switches 18a and 18b. Therefore, uniform plasma treatment can be performed among the devices even when the wafer treating condition is not changed at every device.

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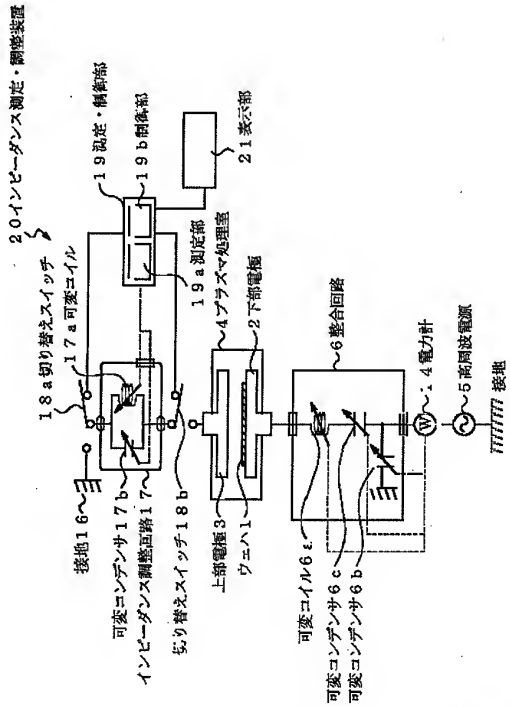
(54)【発明の名称】　半導体装置の製造装置

(57)【要約】
【課題】同一機種の多数の製造装置間に装置のインピーダンスの差が存在していてもそれを容易に補償することにより、ウェハ処理条件を一定にして生産性を向上させる。
【解決手段】対向配置した第１および第２の電極２、３を有するプラズマ処理室４と、第１の電極２に整合回路６を介して接続された高周波電源４と、第２の電極３に接続されるインピーダンス調整回路１７を有するインピーダンス測定・調整手段２０とを具備する。



【特許請求の範囲】

【請求項１】　たがいに対向配置した第１および第２の電極を有するプラズマ処理室と、前記第１の電極に整合回路を介して接続された高周波電源と、前記第２の電極に接続されるインピーダンス調整回路を有するインピーダンス測定・調整手段とを具備したことを特徴とする半導体装置の製造装置。

【請求項２】　前記インピーダンス測定・調整手段には前記インピーダンス調整回路のインピーダンスを測定して該インピーダンスを調整する測定・制御部を有していることを特徴とする請求項１記載の半導体装置の製造装置。

【請求項３】　前記インピーダンス調整回路と前記測定・制御部との間に両者を接続する第１および第２の切り替えスイッチを有していることを特徴とする請求項２記載の半導体装置の製造装置。

【請求項４】　前記第１および第２の切り替えスイッチにより、前記インピーダンス調整回路を前記測定・制御部から切り離して前記プラズマ処理室の前記第２の電極と固定電位との間に接続することを特徴とする請求項３記載の半導体装置の製造装置。

【請求項５】　前記インピーダンス調整回路は可変コンデンサと可変コイルを有して構成されていることを特徴とする請求項１記載の半導体装置の製造装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は半導体装置の製造装置に係り、特に、高周波電力を供給してプラズマを発生させる装置に関する。

【０００２】

【従来の技術】半導体装置の製造段階の半導体ウェハ（以下、ウェハ、と称す）に例えばパターンを形成するドライエッチング装置において、高周波電源からプラズマ処理室に効率よく電力を供給するために、両者間に整合回路を設けている。さらに特開昭６０－２０６０２８号公報にはプラズマ処理室におけるプラズマインピーダンスをモニタしてガス供給系にフィードバックすることのより、処理中のプラズマの放電を安定にする技術が開示されている。この従来技術を図２を参照して説明する。

【０００３】図２の従来技術によるドライエッチング装置において、ウェハ１を搭載する下部電極２と接地された上部電極３とを有するプラズマ処理室４と、高周波電力を供給する高周波電源５と、可変コイル６ａおよび可変コンデンサ６ｂ、６ｃを有して高周波電源５からの電力を整合する整合回路６と、電力計１４とを備えている。

【０００４】さらに、プラズマ処理室４内のインピーダンスを整合回路６内の可変コイル６ａ両端の電位差から算出する演算・制御部７、整合回路６からの各データを与えられたクロックＢによって演算制御部７に転送するデータサンプリング回路１５、演算制御部７からの信号とインピーダンス変動許容値Ａを比較する比較器８、演算制御部７からの信号によって高周波電源５をＯＮ－ＯＦＦするスイッチ９、エッチングガス１０の流量を加減するためのバルブ１１、このバルブを開閉する流量制御器１２、プラズマ処理室４内のインピーダンスを常時モニターする為の表示器１３を具備しており、このような構成によりプラズマインピーダンスをサンプリングしてエッチングガス１０の流量を調節してプラズマインピーダンス変動を抑制するものである。

【０００５】

【発明が解決しようとする課題】しかしながら上記従来技術は、１台ごとの製造装置については有効であるが、半導体装置の量産工場に用いる場合、次に示すような問題を生じる。

【０００６】すなわち量産工場では、同一機種の製造装置を多く（数台～数十台）設置して用いる。この場合、これらの製造装置および設置条件がたがいに全く同一であれば、プラズマ処理において全ての装置に対して同じ処理条件で一括で管理することができる。

【０００７】しかしながら現実には製造装置の部品のばらつき、その製造装置を製造する工程のばらつき、あるいは上部電極と設置間のインピーダンス等の設置条件のばらつきにより製造装置間で製造装置そのもののインピーダンスのばらつき、すなわち装置個体差を生じてしまう。

【０００８】したがって、全てのウェハに対して同じ処理条件で一括で管理することが不可能になり、個々の製造装置ごとに装置個体差に応じてガス流量や印加電圧等の処理条件をそれぞれ変えて使用している。

【０００９】この条件を変えるということは、この処理後のウェハにおける出来上がりの形状を見て行わなくてはならないので、条件出しに時間がかかったり、定期整備で部品の交換のたびに行う必要があり、生産性を低下させる要因となっている。

【００１０】したがって本発明の目的は、同一機種の多数の製造装置間に装置個体差が存在していてもそれを容易に補償することによりウェハ処理条件を一定にすることができ、もって生産性を向上させる半導体装置の製造装置を提供することである。

【００１１】

【課題を解決するための手段】本発明の特徴は、たがいに対向配置した第１および第２の電極を有するプラズマ処理室と、前記第１の電極に整合回路を介して接続された高周波電源と、前記第２の電極に接続されるインピーダンス調整回路を有するインピーダンス測定・調整手段とを具備した半導体装置の製造装置にある。ここで前記インピーダンス測定・調整手段には前記インピーダンス調整回路のインピーダンスを測定して該インピーダンス

を調整する測定・制御部を有していることができる。この場合、前記インピーダンス調整回路と前記測定・制御部との間に両者を接続する第１および第２の切り替えスイッチを有しており、さらにこの第１および第２の切り替えスイッチにより、前記インピーダンス調整回路を前記測定・制御部から切り離して前記プラズマ処理室の前記第２の電極と固定電位との間に接続することが好ましい。また、前記インピーダンス調整回路は可変コンデンサと可変コイルを有して構成されていることができる。

【００１２】このような本発明によれば、インピーダンス調整回路のインピーダンスを調整することにより、装置自身のインピーダンスを多数の装置間で一定となるようにし装置個体差を吸収することができ、これによりそれぞれの装置で処理条件を変える必要が無くなり、生産性が向上する。

【００１３】

【発明の実施の形態】次に本発明について図面を参照して説明する。

【００１４】図１は本発明の実施の形態を示す構成図である。同図において、プラズマ処理室４は、ウェハ１を搭載する下部電極２および、接地端子１６に接続されかつ下部電極と対向配置した上部電極３を含み、図示を省略した排気系により０．０２０～３．０Ｔｏｒｒ程度の圧力で一定になる様に真空排気されると共に、図示を省略したガス流入系から一定流量エッチングガスが流入される。

【００１５】高周波電源５からの高周波電力を整合することにより、効率よくプラズマ処理室に高周波電力を供給する整合回路６がプラズマ処理室の下部電極２に結合し、また高周波電源５と整合回路６との間に電力計１４が設けられている。

【００１６】すなわち整合回路６は、可変コイル６ａと可変コンデンサ６ｂ，６ｃを有してで構成され、エッチングを行う際に高周波電力がプラズマで効率よく消費されるように、高周波電源５から整合回路６を通してプラズマ処理室４へ向かう電力（進行波出力）に対して、プラズマ処理室４から整合回路６を通して高周波電源５へ戻る電力（反射波出力）を、できるだけ小さくするように可変コイル６ａ，可変コンデンサ６ｂ，６ｃを自動的に調整して、インピーダンス整合を行う機能（オートマッチング機能）を有している。

【００１７】さらに本発明では、接地（接地端子）１６と上部電極３の端子との間に接続されるインピーダンス調整回路１７を具備したインピーダンス測定・調整装置（手段）２０が設けられている。このインピーダンス測定・調整装置２０には、インピーダンス調整回路１７の他に測定部１９ａおよび制御部１９ｂを有した測定・制御部１９、表示部２１、一対の切り替えスイッチ１８ａ、１８ｂが設けられている。

【００１８】この切り替えスイッチ１８ａ，１８ｂにより、インピーダンス調整回路１７を、接地１６および上部電極３への接続とインピーダンス測定・制御部１９の両端への接続の切換を可能にしている。

【００１９】またインピーダンス調整回路１７は可変コイル１７ａおよび可変コンデンサ１７ｂを有して構成されている。

【００２０】インピーダンス調整回路１７のインピーダンスを測定する際には、切り替えスイッチ１８ａ，１８ｂによりインピーダンス調整回路１７を接地１６および上部電極３の端子から切り離して測定・制御部１９に接続し、測定部１９ａにおいてインピーダンスを測定し、その測定値を表示部２１により表示する。

【００２１】また、測定部１９ａの測定値により、制御部１９ｂにてインピーダンス調整回路１７内の可変コイル１７ａおよび可変コンデンサ１７ｂを調整して、インピーダンス調整回路１７のインピーダンスが所定の値、すなわちこのインピーダンス調整回路１７を上部電極と接地との間に接続した際に多数の装置間で装置個体差が抑制するような値に表示部２１で表示しながら自動的に調整する。

【００２２】そしてインピーダンスが所定の値となったインピーダンス調整回路１７を切り替えスィッチ１８ａ、１８ｂにより、測定・制御部１９から切り離し、上部電極３の端子と接地１６の端子との間に挿入接続し、プラズマ処理室４においてウェハ１にプラズマ処理を行う。

【００２３】

【発明の効果】このように本発明は、装置自身のインピーダンスを容易に変更できるインピーダンス測定・調整手段を設けたから、同一機種の多数の製造装置間の装置個体差を抑制することができ、これによりそれぞれの装置でウェハ処理条件を変えなくても装置間で均一のプラズマ処理をすることが可能となり、生産性を向上させることができる。

【図面の簡単な説明】

【図１】本発明の実施の形態のプラズマ処理装置を示す図である。

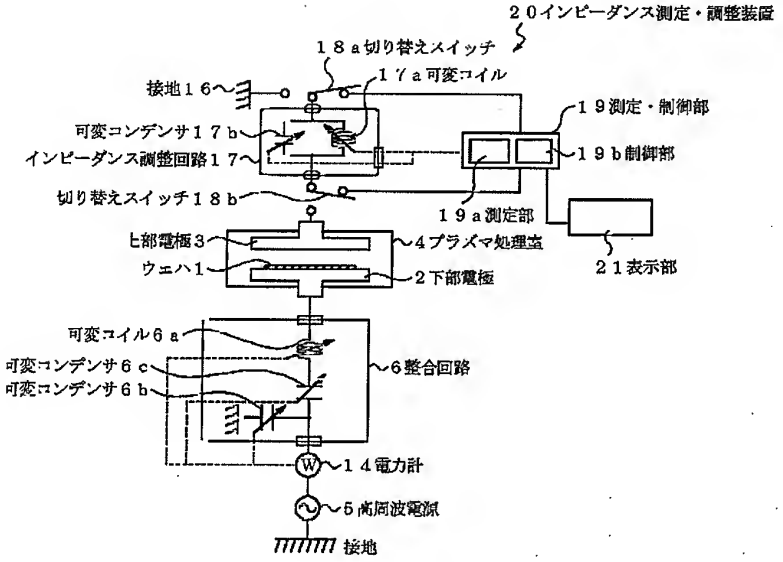
【図２】従来技術のプラズマ処理装置を示す図である。

【符号の説明】

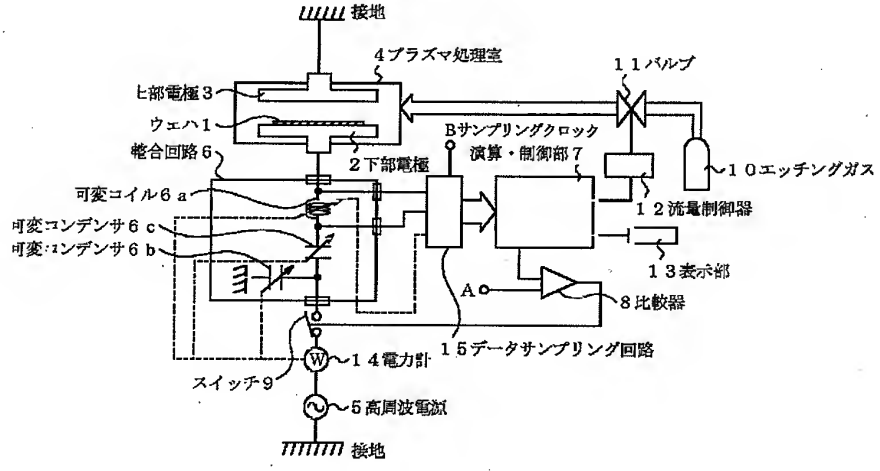
１　ウェハ
２　下部電極
３　上部電極
４　プラズマ処理室
５　高周波電源
６　整合回路
６ａ　可変コイル
６ｂ，６ｃ　可変コンデンサ
７　演算・制御部
８　比較器
９　スイッチ

10　エッチングガス
11　バルブ
12　流量制御器
13　表示器
14　電力計
15　データサンプリング回路
16　接地（接地端子）
17　インピーダンス調整回路
17a　可変コイル
17b　可変コンデンサ
18a，18b　切り替えスイッチ
19　測定・制御部
19a　測定部
19b　制御部
20　インピーダンス測定・調整装置
21　表示部

【図1】



【図2】



PATENT ABSTRACTS OF JAPAN

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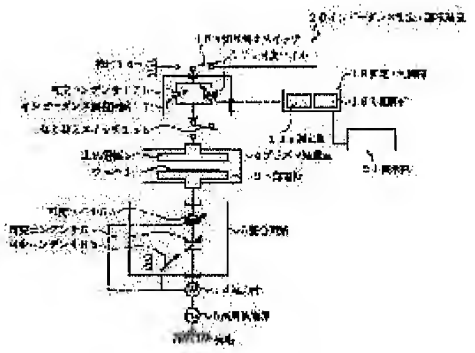
(54) SEMICONDUCTOR DEVICE MANUFACTURING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To make the water treating conductions of the same type of many semiconductor device manufacturing devices constant by compensating the individual differences among the manufacturing devices by providing a high-frequency power source connected to a first electrode through a matching circuit and an impedance measuring and adjusting means having an impedance adjusting circuit connected to a second electrode.
SOLUTION: High-frequency power from a high-frequency power source 5 is efficiently supplied to a plasma treating chamber 4 by connecting a matching circuit 6 to the lower electrode 2 of the chamber 2. Then an impedance measuring and adjusting device 20 having an impedance adjusting circuit 17 is provided between a ground 16 and an upper electrode 3 and an impedance is automatically adjusted while the impedance is displayed on a displaying section 21 so as to suppress the individual differences among many devices. When the impedance becomes a prescribed value, a wafer 1 is treated with plasma by connecting the adjusting circuit 17 to the upper electrode 3 and ground 16 by means of change-over switches 18a and 18b. Therefore, uniform plasma treatment can be performed among the devices even when the wafer treating condition is not changed at every device.



LEGAL STATUS

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[Date of extinction of right]	14.01.2003

* NOTICES *

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3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The manufacturing installation of the semiconductor device characterized by providing the plasma treatment room which has the 1st and 2nd electrodes which carried out opposite arrangement mutually, the RF generator connected to said 1st electrode through the matching circuit, and the impedance measurement and the adjustment device which have the impedance equalization circuit connected to said 2nd electrode.
[Claim 2] The manufacturing installation of the semiconductor device according to claim 1 characterized by having the measurement and the control section which measures the impedance of said impedance equalization circuit to said impedance measurement and adjustment device, and adjusts this impedance.
[Claim 3] The manufacturing installation of the semiconductor device according to claim 2 characterized by having the 1st and 2nd changeover switches which connect both between said impedance equalization circuit, and said measurement and control section.
[Claim 4] The manufacturing installation of the semiconductor device according to claim 3 characterized by separating said impedance equalization circuit from said measurement and control section, and connecting between said 2nd electrode of said plasma treatment room, and fixed potential with said 1st and 2nd changeover switches.
[Claim 5] Said impedance equalization circuit is the manufacturing installation of the semiconductor device according to claim 1 characterized by having a variable capacitor and a variable coil and being constituted.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacturing installation of a semiconductor device, and relates to the equipment which supplies high-frequency power and is made to generate the plasma especially.
[0002]
[Description of the Prior Art] In the dry etching system which forms a pattern in the semi-conductor wafer (it is hereafter called a wafer) of the manufacture phase of a semiconductor device, in order to supply power to a plasma treatment room efficiently from an RF generator, the matching circuit is prepared among both. From that of carrying out the monitor of the plasma impedance in a plasma treatment room to JP,60-206028,A furthermore, and feeding back to a gas supply system, the technique which carries out discharge of the plasma under processing to stability is indicated. This conventional technique is explained with reference to drawing 2 .
[0003] In the dry etching system by the conventional technique of drawing 2 , it has the plasma treatment room 4 which has the lower electrode 2 carrying a wafer 1, and the grounded up electrode 3, RF generator 5 which supplies high-frequency power, the matching circuit 6 which has variable coil 6a and variable capacitors 6b and 6c, and adjusts the power from RF generator 5, and the wattmeter 14.
[0004] Furthermore With the clock B which was able to give each data from an operation and a control section 7, and a matching circuit 6 which computes the impedance in the plasma treatment room 4 from the potential difference of the variable coil 6a both ends in a matching circuit 6 With the signal from the data sampling circuit 15 transmitted to the operation control section 7, the comparator 8 which compares the signal from the operation control section 7 with the impedance fluctuation allowed value A, and the operation control section 7 The drop 13 for always acting as the monitor of the impedance in the bulb 11 for adjusting the flow rate of the switch [ON-OFF / switch / RF generator 5] 9, and etching gas 10, the rate controller 12 which open and close this bulb, and the plasma treatment room 4 is provided. A plasma impedance is sampled by such configuration, the flow rate of etching gas 10 is adjusted, and plasma impedance fluctuation is controlled.
[0005]
[Problem(s) to be Solved by the Invention] However, although the above-mentioned conventional technique is effective about the manufacturing installation in every set, when using for the volume-production facility of a semiconductor device, it produces a problem as shown below.
[0006] That is, in a volume-production facility, many (several - dozens of sets) manufacturing installations of the same model are installed, and are used. In this case, if these manufacturing installations and installation conditions are completely mutually the same, in plasma treatment, it is manageable on the same processing conditions to all equipments with a package.
[0007] However, it will produce between manufacturing installations actually by dispersion in installation conditions, such as dispersion in the components of a manufacturing installation, dispersion of the process which manufactures the manufacturing installation, or an impedance between an up

electrode and installation, dispersion, i.e., the equipment individual difference, of an impedance of the manufacturing installation itself.
[0008] Therefore, it becomes impossible, and managing by package on the same processing conditions to all wafers is using processing conditions, such as a quantity of gas flow and applied voltage, according to equipment individual difference for each manufacturing installation of every, changing them, respectively.
[0009] since it must carry out by seeing the configuration of the completion in the wafer after this processing, carrying out condition appearance needs to take time amount, or it is necessary to perform changing this condition at every exchange of components by scheduled maintenance, and it has become the factor which reduces productivity.
[0010] Therefore, the purpose of this invention is offering the manufacturing installation of the semiconductor device which can make wafer processing conditions regularity, has them and raises productivity by compensating it easily, even if equipment individual difference exists between the manufacturing installations of a majority of same models.
[0011]
[Means for Solving the Problem] The description of this invention is in the manufacturing installation possessing the plasma treatment room which has the 1st and 2nd electrodes which carried out opposite arrangement mutually, the RF generator connected to said 1st electrode through the matching circuit, and the impedance measurement and the adjustment device which have the impedance equalization circuit connected to said 2nd electrode of a semiconductor device. It can have the measurement and the control section which measures the impedance of said impedance equalization circuit to said impedance measurement and adjustment device here, and adjusts this impedance. In this case, it has the 1st and 2nd changeover switches which connect both between said impedance equalization circuit, and said measurement and control section, and it is desirable to separate said impedance equalization circuit from said measurement and control section, and to connect between said 2nd electrode of said plasma treatment room and fixed potential with these 1st and 2nd changeover switches, further. Moreover, said impedance equalization circuit has a variable capacitor and a variable coil, and can be constituted.
[0012] According to such this invention, by adjusting the impedance of an impedance equalization circuit, the own impedance of equipment is made to become fixed among much equipments, equipment individual difference can be absorbed, the need that this changes processing conditions with each equipment is lost, and productivity improves.
[0013]
[Embodiment of the Invention] Next, this invention is explained with reference to a drawing.
[0014] Drawing 1 is the block diagram showing the gestalt of operation of this invention. In this drawing, while evacuation of the plasma treatment room 4 is carried out so that it may become fixed by the pressure of 0.020 - 3.0Torr extent by the exhaust air system which omitted illustration including the lower electrode 2 carrying a wafer 1, and the up electrode 3 which was connected to the earth terminal 16 and carried out opposite arrangement with the lower electrode, constant-flow etching gas flows from the gas inflow system which omitted illustration.
[0015] By adjusting the high-frequency power from RF generator 5, the matching circuit 6 which supplies high-frequency power to a plasma treatment room efficiently combines with the lower electrode 2 of a plasma treatment room, and the wattmeter 14 is formed between RF generator 5 and the matching circuit 6.
[0016] that is, a matching circuit 6 so that high-frequency power may be efficiently consumed by BURAZUMA in case it etches by having variable coil 6a and variable capacitors 6b and 6c, and being come out and constituted As opposed to the power (progressive wave output) which goes to the plasma treatment room 4 through a matching circuit 6 from RF generator 5 Variable coil 6a and variable capacitors 6b and 6c are automatically adjusted so that power (reflected wave output) which returns from the plasma treatment room 4 to RF generator 5 through a matching circuit 6 may be made as small as possible, and it has the function (auto matching function) to perform impedance matching.
[0017] Furthermore by this invention, the impedance measurement and the adjusting device 20 (means)

possessing the impedance equalization circuit 17 connected between touch-down (earth terminal) 16 and the terminal of the up electrode 3 are formed. Measurement and the control section 19 with test-section 19a and control-section 19b, a display 21, and the changeover switches 18a and 18b of a pair are formed in this impedance measurement and adjusting device 20 besides the impedance equalization circuit 17.
[0018] The change-over of connection with touch-down 16 and the up electrode 3 and connection with the both ends of impedance measurement and a control section 19 of the impedance equalization circuit 17 is enabled with these changeover switches 18a and 18b.
[0019] Moreover, the impedance equalization circuit 17 has variable coil 17a and variable-capacitor 17b, and is constituted.
[0020] In case the impedance of the impedance equalization circuit 17 is measured, the impedance equalization circuit 17 is separated from the terminal of touch-down 16 and the up electrode 3 with changeover switches 18a and 18b, it connects with measurement and a control section 19, an impedance is measured in test-section 19a, and the measured value is displayed by the display 21.
[0021] Moreover, it adjusts automatically, displaying on a value which equipment individual difference controls among much equipments by the display 21, when variable coil 17a and variable-capacitor 17b in the impedance equalization circuit 17 are adjusted in control-section 19b and the impedance of the impedance equalization circuit 17 connects between an up electrode and touch-down with the measured value of test-section 19a, predetermined value 17, i.e., this impedance equalization circuit.
[0022] And the impedance equalization circuit 17 where the impedance became a predetermined value is changed, by SUITCHI 18a and 18b, it separates from measurement and a control section 19, insertion connection is made between the terminal of the up electrode 3, and the terminal of touch-down 16, and plasma treatment is performed to a wafer 1 at the plasma treatment room 4.
[0023]
[Effect of the Invention] Thus, since this invention prepared the impedance measurement and the adjustment device which can change the own impedance of equipment easily, it can control the equipment individual difference between the manufacturing installations of a majority of same models, even if it does not change wafer processing conditions with each equipment by this, it can become possible [carrying out plasma treatment of homogeneity between equipment], and can raise productivity.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the plasma treatment equipment of the gestalt of operation of this invention.
[Drawing 2] It is drawing showing the plasma treatment equipment of the conventional technique.
[Description of Notations]
1 Wafer
2 Lower Electrode
3 Up Electrode
4 Plasma Treatment Room
5 RF Generator
6 Matching Circuit
6a Variable coil
6b, 6c Variable capacitor
7 Operation and Control Section
8 Comparator
9 Switch
10 Etching Gas
11 Bulb
12 Rate Controller
13 Drop
14 Wattmeter
15 Data Sampling Circuit
16 Touch-down (Earth Terminal)
17 Impedance Equalization Circuit
17a Variable coil
17b Variable capacitor
18a, 18b Changeover switch
19 Measurement and Control Section
19a Test section
19b Control section
20 Impedance Measurement and Adjusting Device
21 Display

[Translation done.]